CLAIMS

1. A laser for producing a third, fourth or fifth harmonic beam comprising;

a) a first reflector and a second reflector forming a resonator having an optical axis, said resonator including a laser medium for producing a fundamental beam; said first reflector highly reflective of fundamental beam;

b) a second harmonic generator located within said resonator for generating a second harmonic beam from said fundamental beam;

c) said second reflector at least partially reflective for fundamental beam;

d) said resonator producing two resonator output beams of preselected different wave length at least one of which is a harmonic beam;

e) one or more output couplers to remove at least a portion of said two output beams from said resonator and direct said removed beams on preselected optical paths outside said resonator;

f) a third, fourth or fifth harmonic nonlinear crystal located outside said resonator cavity and located along the preselected optical paths of both output beams to produce a third, fourth or fifth harmonic beam from said two output beams.

2. The laser according to claim 1 wherein said second harmonic generator is located within said resonator so that said fundamental beam makes a first and second pass across said second harmonic generator.

3. A third harmonic laser according to claim 1 further comprising said output couplers of paragraph (e), include a first output coupler located within said resonator to direct said second harmonic beam outside said cavity on said preselected path;

a second output coupler to direct fundamental beam outside said cavity on said preselected path;

said nonlinear crystal of paragraph f being a third harmonic nonlinear crystal.

4. A third harmonic laser according to claim 3 wherein said third harmonic nonlinear crystal is LBO, BBO or CLBO.

5. The laser according to claim 3 wherein said second harmonic nonlinear crystal is selected from the group LBO, BBO, KTP and CLBO crystals.

6. The laser according to claim 3 wherein said second harmonic nonlinear crystal is cut for critical phase matching.

7. The laser according to claim 3 wherein said third harmonic crystal is oriented to at least partially compensate for walk off generated from the second harmonic generator.

8. The laser according to claim 3 wherein said second harmonic generator is a LBO crystal cut for critical phase matching and the third harmonic generator is a LBO crystal oriented to at least partially compensate for walk off generated from said second harmonic generator.

9. The laser according to claim 3 further comprising a focus optics system located outside of the laser cavity to focus said beams propagating from said output couplers prior to said beams incidenting on third harmonic generator.

10. The laser according to claim 3 wherein said laser medium is Nd:YAG, Nd:YLF or $Nd:YV0_4$.

11. A fourth harmonic laser according to claim 1 further comprising;

g) a third harmonic generator located within said cavity;

h) means to direct both fundamental and second harmonic beam through said third harmonic generator to produce third harmonic beam in said cavity;

said output coupler of paragraph e including a first output coupler located within said resonator cavity to direct third harmonic beam outside said cavity on said preselected path;

a second output coupler to direct fundamental beam outside said cavity on said preselected path;

said nonlinear crystal of paragraph f being a fourth harmonic nonlinear crystal cut for fourth harmonic generation 1w + 3w.

12. The laser according to claim 11 wherein said second harmonic generator is located within said resonator so that said fundamental beam makes a first and second pass across said second harmonic generator.

13. The laser according to claim 12 wherein said fourth harmonic nonlinear crystal is a LBO nonlinear crystal.

14. The laser according to claim 11 wherein said third harmonic nonlinear crystal is LBO, BBO or CLBO.

15. The laser according to claim 11 wherein said second harmonic nonlinear crystal is selected from the group LBO, BBO, KTP and CLBO crystals.

16. A fifth harmonic laser according to claim 1 further comprising;

g) a third harmonic generator located within said cavity;

h) means to direct both fundamental and second harmonic beam through said third harmonic generator to produce third harmonic beam in said cavity;

said output coupler of paragraph e including a first output coupler located within said resonator cavity to direct third harmonic beam outside said cavity on said preselected path; a second output coupler to direct second harmonic beam outside said cavity on said preseleted path;

said nonlinear crystal of paragraph f being a fifth harmonic nonlinear crystal cut for fourth harmonic generation 2w + 3w.

17. A fifth harmonic laser according to claim 1 further comprising;

g) a third harmonic generator located within said cavity;

h) a fourth harmonic generator located within said cavity;

i) means to direct both fundamental and second harmonic beam through said third harmonic generator to produce third harmonic beam in said cavity;

j) means to direct both third and fundamental beam through said fourth harmonic generator to produce a fourth harmonic beam in said cavity;

said output coupler of paragraph e including a first output coupler located within said resonator cavity to direct fourth harmonic beam outside said cavity on said preselected path; a second output coupler to direct fundamental beam outside said cavity on said preseleted path; and

said nonlinear crystal of paragraph f being a fifth harmonic nonlinear crystal cut for fourth harmonic generation 1w + 4w.